Contribution of TAF to climate change adaptation and mitigation in Ethiopia

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Outline

1. AF and CC adaptation and mitigation
2. Tree crop interaction
3. Tree animal interaction
4. Concluding remarks

1. AF and CC adaptation and mitigation

1. CC Adaptation = reduced vulnerability

a. Ecosystem :

(i) **increased organic matter content of soil,**

(ii) **enhanced efficient nutrient cycling, hence maintaining soil fertility,**

(iii) **control of soil erosion and water**

(iv) **maintaining biodiversity conservation on agricultural landscapes.**

b. Social/ socioecnomic

- Livelihood diversification
- maintaining production during wetter and drier years
- Product diversification

2. CC mitigation

Carbon sequestration

1. Contribution of TAF to CC adaptation–

a.**Reduce ecosystem vulnerability**

A. Biodiveristy

diversity

Plant species

Animal species

Microorganism

Landscape

connectivity

1. Contribution of TAF to CC adaptation–

a.**Reduce ecosystem vulnerability**

Landscape connectivity

a.**Reduce ecosystem vulnerability**

Rehabilitation through AF trees at Halaba

a.Reduce ecosystem vulnerability

Nitrogen (N) and Phosphorus (P) composition of litter from five Tree-Species, coffee and Enset crops (Temaledegn Feleke, 2008)

Species	N mgg^{-1}	P mgg^{-1}
Cordia africana	19.80	0.78
Ensete ventricosum	11.40	1.24
Persea americana	8.90	0.33
Millettia ferruginea	23.80	0.59
Croton macrostachys	17.80	0.49
Ficus vasta	8.90	0.91
Coffee arabica	10.80	0.26

a. Reduce ecosystem vulnerability

Some selected soil properties, Gedeo

Soil Parameters	homegarden	Village forest garden	Mono-cropping
	Tree coffee-enset	Tree –coffee-root crops	
OC %	2.97a	2.7la	1.76b
SOM %	5.12a	4.67a	3.03b
TN %	0.28a	0.26a	0.20b
P(PPM)	23.91a	10.45b	8.7b
CEC	23.7a	20.7a	14.4a
P^H	6.25a	6.0a	5.65a
K	4.96a	6.9a	2.19b

Water quality from agroforestry for watershed management, Gedeo

Water quality from areas with less vegtation cove, Boreda

b. CC adaptation Livelihood - diversification Gedeo

Income sources	In percent
Cereal crops (maize)	5
Tree (timber, fruit trees, coffee)	57
Honey production	10
Enset production	20
Livestock (sheep, goat and poultry)	5
Yam and vegetables (cabbage)	3
(Mesele, 2007)	

b. CC adaptation Livelihood -Intensification through fruit tree based AF

Intensification through enset-coffee-tree and fruit tree based AF

b. CC adaptation Livelihood

b. CC adaptation Livelihood

2. CC mitigation under MSAF

Area	Estimated parameters	Mg ha^{-1}	Source
Gedeo agroforest	Biomass Carbon	29.13	Fikere 2011
	Soil stock	66.65	
	total	95.78	
South west (Jima)	native coffee forest	230	Mohammed 2011
	Agroforestry based	150	
	Annual crop fields	65	
Elsewhere	agroforests in humid areas	100	Motagnini and Nair, 2004

2. CC mitigation under under parkland AF .Worku Belayhun 2011

SOC (Mg/ha)		Bulbula	Debre Zeit
Depth	0-15 cm	14.89±2.48	19.83±1.38
	15-30 cm	7.6±0.58	19.75±0.83
Total SOC (Mg/ha)		11.25±1.63	19.79±0.77
AGTBC (Mg/ha)		**(16 stem/ha)** 9.33±2.25[1]	**(5tree/ha)** 5.49±0.63[2]
BGTBC (Mg/ha)		2.332	1.37
Total C (Mg/ha)		**22.912**	**26.65**
Semi arid		9	Motagnini and

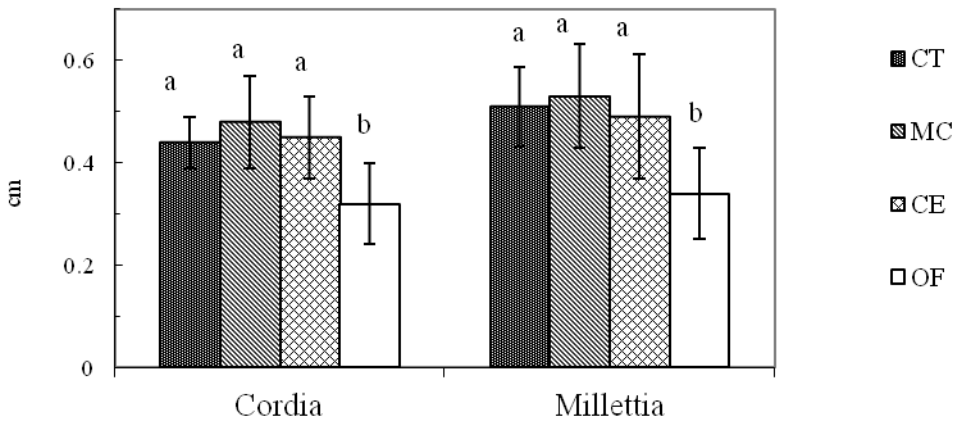
2. Tree-crop interaction

Topsoil chemical properties on enset fields as influenced by upper storey Cordia and Millettia trees (Zebene 2003)

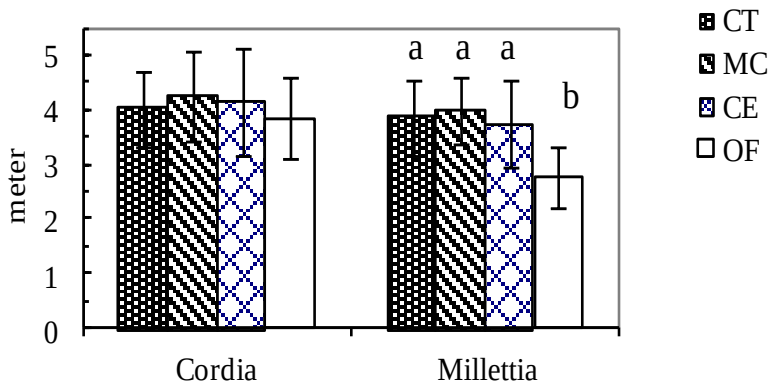
Variable description	Cordia		Millettia	
	Under canopy	Out side	Under canopy	Out side
total N%	0.34a	0.27b	0.35a	0.26b
Organic C%	3.35a	2.69b	2.67a	2.34b
pH (H2o)	7.01a	6.65b	6.55a	6.06b
available P PPM	15.42a	5.07b	9.03a	4.94b
CEC Meq/100gm	27.69a	22.78b	27.3a	23.09a

Influence of Cordia and Millettia on Enset growth (Zebene 2003)

- Mean diameter of pseudostem at thickest height of four year old *Enset ventricosum* grown under Cordia and Millettia and open fields.



- Mean height of four year old *Enset ventricosum* grown under *Cordia africana* and *Millettia ferruginea* and open field



Crop yield increase under canopy of *Faidherbia albida*

Faidherbia + Crop type	Crop yield increase (%) under canopy of Faidherbia	Reference
Maize in Malawi	100	Saka et al., 1994),
Maize in Ethiopia	76	Poschen, 1986);
Sorghum in Ethiopia	36	Poschen, 1986);
Sorghum in Burkina Faso	125	Depommier et al., 1992);
Millet Senegal	250	Charreau and Vidal, 1965).
Cheapea Ethiopia	32	(Yadessa, 2010

Mean values for soil parameters Faiherbia and open chickpea fields ,Welenchiti, Yadessa 2010

Soil parameters	A under	B Open field	A/B*100
Moisture content (%)	37.76	27.60	+37%
Bulk density (gm/cm3)	0.951	1.046	-10%
Organic Carbon (%DM)	1.83	1.33	+38%
Total Nitrogen (%DM)	0.19	0.13	+46%
Available P (mg/kg)	11.86	3.21	+3.7 times
pH-H2O (1:2.5)	9.08	8.69	+4%
Excha. Na (cmol(+)/kg)	0.35	0.22	+59%
Excha. K (cmol(+)/kg)	3.85	2.95	+31%
Excha. Ca (cmol(+)/kg)	58.03	46.55	+25%
Excha. Mg (cmol(+)/kg)	3.57	2.80	+27%
Chickpea yield kg per ha	2056	1562.5	32%

Effect of parkland trees on wheat yield Gurage Zone, Beressa watershed Gossyae Degu (2010)

species	distance	*Yield (q/ha)*	*Yield (% over control)*
F. albida	.05m	47.61^{b}	*206.38*
	1m	56.31^{a}	*244.11*
	2m	42.01^{b}	*182.13*
	10m	23.07^{c}	
P. americana	.05m	0.45^{b}	*1.79* ***(56F)***
	1m	1.10^{b}	*4.52* ***(23F)***
	2m	1.47^{b}	*5.84* ***(17F)***
	10m	25.23^{a}	

Effect of Avocado on Maize Yields **Damot Gale Mesfin Kasa 2009**

Tree DTB m	Total biomass tone per ha	Grain yield tone per ha
0.5-1	0.68 (10%) **< by 9.8 F**	0.08 (3.5%) **< by 29**
2-2.5	1.74 (26 %) **< by 3.8F**	0.42 (18%) **<by 5.5**
4.5-5	4.56 (68%) **< by1.5F**	1.51(66%) **< by 1.5**
16 open field	6.69	2.3

Sorghum yield as influenced by *Acacia Senegal* and open field in Mieaso

Relative illumination

Under 65 % < 100% OF

Soil moisture

under 12% >7.5 % OF

soil temperature

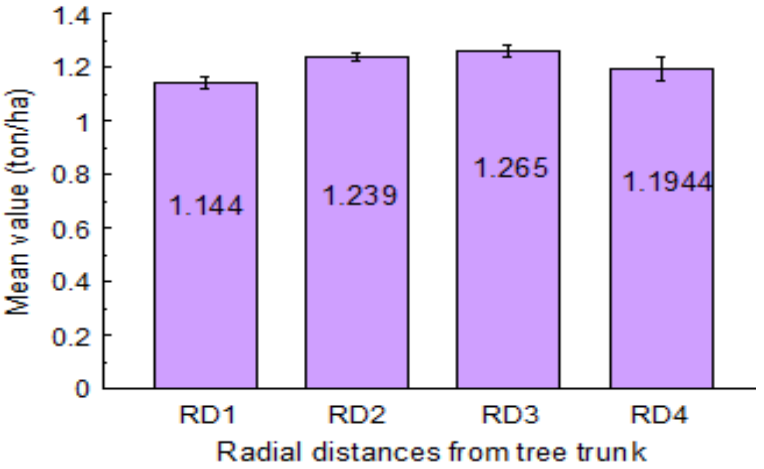
under 32^{O}t < 36 OF

SOC (31%) higher under

N (22%); higher under

P (33%); higher under

K (33%) higher under



Mean value of sorghum yield (ton/ha). **Under canopy yield is greater than open field by 2%**

Moringa stenopetala

Moringa stenopetala

3.Tree-animal interaction

A. traditional agrosilvopasture
B. Forage trees on crop fields
C. Forage trees on grazing lands
D. Shade provision
E. Entemoforestry


Pod boundary planting

Multipurpose boundary planting

Rainy season

Dry season

Concluding remarks

1. In intensification, the hidden half of plant soil interaction requires particular attention
2. Intensification of agri. Should also give emphasis to already existing AF systems
3. Introduction such **treerow, water break, pasture with plantation forestry, aquaforestry, protein bank AF practices**
4. Special attention has to be given to managers of AF intensification

Let us learn from proven techniques